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# (54) Digital image decoding apparatus

(57) Data which has been decoded by a decoding portion 101 are compressed by a compressing portion 102 and stored in a prediction / display frame memory portion 103. From the data stored in the prediction / display frame memory portion 103, any data required for decoding other frames in the decoding portion 101 are decompressed through a decompressing A portion 104 and supplied to the decoding portion 101. Alternatively, data to be displayed is read from the prediction / display frame memory portion 103, decompressed at a decompressing B portion 105 and supplied to a display apparatus. Writing to and reading from the above-mentioned prediction / display frame memory portion 103 is controlled by an address controlling portion 106. Since compressed data are stored in the prediction / display frame memory portion 103, the memory capacity can be decreased.

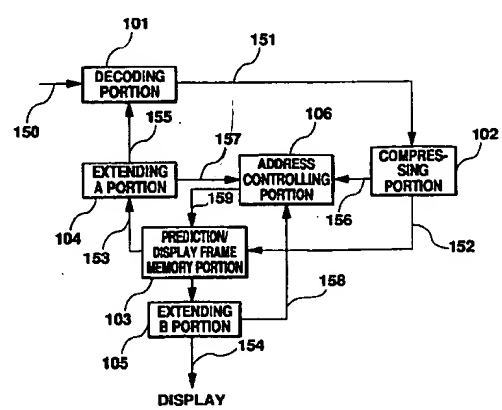


Fig. 1

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decoding means, and an address controlling means for controlling the reading and writing of compressed data to and from the prediction frame memory means.

In this configuration, data which have been decoded by the decoding means are compressed by the compressing means. Therefore the data which is stored in the prediction frame memory means is data which have been compressed by the compressing means. Consequently, a smaller capacity prediction frame memory means is sufficient. Moreover, since the capacity of the prediction frame memory means can be reduced, the data range for addressing, reading or writing is also reduced and the entire apparatus can be scaled-down. Thus, the hardware configuration of the digital image decoding apparatus is simplified, processing can be accomplished at higher speed, and the processing of moving image data can be more efficiently carried out.

(2) In another digital image decoding apparatus of the present invention, the apparatus described in above-mentioned item (1) also has a display frame memory means for retaining at least one image frame of the block unit compressed data obtained by the compressing means which is to be used for display only.

In this configuration, as with the prediction frame memory means, the capacity of the display frame memory means can be reduced and the entire apparatus can be scaled-down. Thus the hardware configuration of the digital image decoding apparatus is simplified, processing can be accomplished at higher speed and the processing of moving image data can be more efficiently carried out.

(3) In another digital image decoding apparatus of the present invention, the apparatus described in above-mentioned item (1) is configured such that the compressing means deems one of the pixels which constitute the block as a standard pixel and first quantizes the data of the standard pixel, and then quantizes pixels other than the standard pixel based on the differences of the coded data of positionally adjoining pixels.

In this configuration, quantizing of the differences of the coded data of positionally adjoining pixels other than the standard pixel is carried out. Since the data for adjoining pixels usually do not differ greatly, even if the number of bits used when quantizing the differences of the coded data is reduced, any image deterioration resulting from this compression will not be extensive. Therefore compression can be carried out with little deterioration.

(4) In another digital image decoding apparatus of the present invention, the apparatus described in above-mentioned item (1) is configured such that the compressing means deems one standard pixel in each pixel row quantizes of the block,, and first the data of the standard pixel, and then quantizes pixels other than the standard pixel based on the differences of the coded data of adjoining pixels within the pixel row to which the pixels belong.

In this configuration, quantizing of the differences of the coded data of adjoining pixels other than the standard pixel is carried out. Since the data for adjoining pixels usually do not differ greatly, even if the number of bits used when quantizing the differences of the coded data is reduced, any image deterioration resulting from this compression will not be extensive. Therefore compression can be carried out with little deterioration.

(5) In another digital image decoding apparatus of the present invention, the apparatus described in above-mentioned item (1) is configured such that the compressing means allocates a small amount of information to a high frequency signal and allocates a large amount of information to a low frequency signal when compressing.

In this configuration, by allocating a large amount of information to a low frequency signal, which has a large degree of influence on image quality, and allocating a small amount of information to a high frequency signal, which has a minor influence on image quality, an image can be compressed with little deterioration. Thus compression can be carried out with little image deterioration.

(6) In another digital image decoding apparatus of the present invention, the apparatus described in above-mentioned item (1) also includes a block data amount controlling means which controls the compressing rate so that the data amount of each block compressed by the compressing means will be less than a predetermined data amount.

In this configuration, the compressing rate can be altered in accordance with the image information and any deterioration in image quality can be limited. For instance, provided that the amount of information after compressing is less than the predetermined data amount, compressing processing is carried out using a method with little image deterioration. Compressing processing using a method which can cause higher image deterioration is used only in cases in which the predetermined value is exceeded. Consequently, the overall deterioration in image quality can be limited when compared to cases where a single ordinary compression method is used.

(7) In another digital image decoding apparatus of the present invention, the compressing means and the block data amount controlling means of the apparatus described in item (6) are configured as described below.

The compressing means compresses the data of each block both by: a first compressing method in which one of the pixels which constitute the block is deemed a standard pixel and the data of pixels other than the standard pixel are expressed as differences of the coded data between adjoining pixels, and a short word-length is allocated for these differences of the coded data when the differences are close to zero and a long word-length is allocated for the differences which are larger; and by a second compressing method in which one of the pixels which constitute the block is deemed a standard pixel and first the data of the standard pixel is quantized, and then the data of pixels other than the standard pixel are quantized, with a predetermined quantization bit number, based on the differences of the coded data of adjoining pixels.

ignated amount. Alternatively, in a case where initially the data amount is small and a small region of memory would be used, image deterioration can be reduced by only compressing a little.

(11) In another digital image decoding apparatus of the present invention, the frame data amount controlling means of the apparatus described in item (10) also includes a block data amount controlling means which controls the compressing rate to ensure that the data amount of each block compressed by the compressing means is less than a predetermined data amount, wherein the compressing means and the frame data amount controlling means are configured as described below.

The compressing means compresses the data of each block both by: a first compressing method in which one of the pixels which constitute the block is deemed a standard pixel and the data of pixels other than the standard pixel are expressed as differences of the coded data between adjoining pixels, and a short word-length is allocated for the differences of the coded data when the differences are close to zero and a long word-length is allocated for the differences which are larger; and by a second compressing method in which one pixel in each of the pixel rows of the block is deemed a standard pixel and first the data of the standard pixel is quantized, and then the data of pixels other than the standard pixel are quantized, with a predetermined quantization bit number, based on the differences of the coded data of adjoining pixels within the pixel row to which the pixel belongs.

Moreover, if the data amount of the data which have been compressed by the first compressing method of the compressing means is less than the maximum permitted value set by the frame data amount controlling means, the block data amount controlling means sends an instruction to the compressing means to output the data resulting from the first compressing method, and, if the data amount of the data which have been compressed by the first compressing method is greater than the set maximum permitted value, the block data amount controlling means chooses a quantization bit number to ensure that the data amount will be less than the set maximum permitted value, and sends an instruction to the compressing means to compress the data resulting from the second compressing method using the chosen quantization bit number.

In this configuration, the compressing rate can be altered in accordance with the image information and any deterioration in image quality can be limited. In particular, in a case where initially the data amount is large and a large memory region would be used, by further compression the data amount of each frame can be limited to a designated amount. Alternatively, in a case where initially the data amount is small and a small region of memory would be used, image deterioration can be reduced by only compressing a little.

Moreover, in the compressing of individual blocks, the first compressing method, in which there is little image deterioration and only minimal compressing is carried out, and the second compressing method, in which there is higher image deterioration but more precise compressing, can be used as appropriate to the block which is to be compressed. In addition, in the second compressing method, since the quantization bit number can also be adjustably controlled the compressing rate can be even more suitably controlled. Thus, by controlling the compressing rate as appropriate to the image information which is to be compressed, even when using a memory with a comparatively small capacity, compressing can be carried out with little image deterioration.

(12) In another digital image decoding apparatus of the present invention, the apparatus described in item (10) also includes a block data amount controlling means which controls the compressing rate to ensure that the data amount of each block compressed by the compressing means is less than a predetermined data amount, and the compressing means and the frame data amount controlling means are configured as described below.

The compressing means compresses the data of each block both by: a first compressing method in which one of the pixels which constitute the block is deemed a standard pixel and the data of pixels other than the standard pixel are expressed as differential coded data between adjoining pixels, and a short word-length is allocated for these differences of the coded data when the differences are close to zero and a long word-length is allocated for the differences which are larger; and by a second compressing method in which one pixel in each of the pixel rows of the block is deemed a standard pixel and first the data of the standard pixel is quantized, and then the data of pixels other than the standard pixel are quantized, with a predetermined quantization bit number, based on the differences of the coded data of adjoining pixels within the pixel row to which the pixel belongs.

Moreover, if the data amount of the data which have been compressed by the first compressing method of the compressing means is less than the maximum permitted value set by the frame data amount controlling means, the block data amount controlling means sends an instruction to the compressing means to output the data resulting from the first compressing method, and, if the data amount of the data which have been compressed by the first compressing method is greater than the set maximum permitted value, the block data amount controlling means chooses a quantization bit number to ensure that the data amount will be less than the set maximum permitted value, and sends an instruction to the compressing means to compress the data resulting from the second compressing method using the chosen quantization bit number.

In this configuration, the compressing rate can be altered in accordance with the image information and any deterioration in image quality can be limited. In particular, in a case where initially the data amount is large and a large memory region would be used, by further compression the data amount of each frame can be limited to a des-

memory portion 103.

In this configuration, the prediction / display frame memory portion 103 can be configured with a smaller capacity than the data amount of the target image data because the stored data is compressed.

Fig. 3 is a diagram showing the relation between display frames and prediction frames when coded image data is decoded. Fig. 4 shows the configuration of the memory regions of the prediction / display frame memory portion 103.

Prediction frames 301 are stored in a prediction frame region 310 and are used in both the decoding of other prediction frames and in the decoding of display frames 302. The display frames 302 are stored in a display frame memory region 311 and are used only for display.

Next, quantizing processing in the present embodiment will be described with reference to Figs. 5 and 6. Fig. 5 shows a block, which is one portion of one image frame, comprising 8 * 8 pixels. The data for each pixel are identified by a code $M_{xy}$ where x is the vertical sequential order and y is the horizontal sequential order. As the diagram shows, the upper left pixel is $M_{00}$ and the bottom right pixel is $M_{77}$.

In quantization, one of the pixels in this block, for instance pixel $M_{00}$, is used as a standard pixel, and for this standard pixel $M_{00}$, the uncompressed data is used as it is. The other pixels in the block are quantized using the differences of the coded data of adjoining pixels. For instance, for the pixel $M_{x0}$ in the (y = 0) left end column, quantizing is carried out based on

$$M'_{x0} = Q\,[M_{x0} - M_{(x-1)0}] \tag{1}$$

while for pixels $M_{xy}$ other than those above, (i.e. y≠0), quantizing is carried out based on

$$M'_{xy} = Q\,[M_{xy} - M_{x(y-1)}] \tag{2}$$

$M'_{xy}$ indicates the data in a pixel after quantizing and Q [] indicates the quantizing process.

For instance, if the data for each pixel before quantizing is 8 bits, then the differential data are indicated by 9 bits (-256~255). If these are quantized with for instance 4 bits, a typical quantizing value of less than 16 can be used. In addition, since the differential of adjoining pixels is usually close to zero, it is acceptable to carry out non-linear quantizing as shown in Fig. 6 whereby the quantizing range is decreased when the differential is around zero and increased as the differential departs from zero.

According to this type of quantizing, by storing the standard pixel $M_{00}$ with 8 bits and other pixels with 4 bits, the quantizing data amount becomes

$$\text{(data amount after compression)} = 8 + 4 * (8 * 8 - 1) = 260 \text{ bits} \tag{3}$$

while the data amount before compression is

$$\text{(data amount before compression)} = 8 * 8 * 8 = 512 \text{ bits} \tag{4}$$

thus the compression rate (data amount before compression - data amount after compression / data amount before compression) is approximately 50%.

Quantizing processing can also be carried out by further subdividing the block, selecting one pixel within each of the resulting small blocks as a standard pixel, and then calculating differential data for the remaining pixels within the small blocks which can then be quantumized.

For instance, one line of the block shown in Fig. 5 can be predetermined as the small block, and the pixel on the far left of each small block can be designated as the standard pixel. In other words, pixel $M_{x0}$ becomes a standard pixel and its data prior to compression are used as they are. For the other pixels, that is, for pixels where y≠0, quantizing is carried out based on equation (2) described above. Moreover, with regard to the quantizing range, it is acceptable to carry out non-liner quantizing as shown in Fig. 6.

As in the above-mentioned case, if quantizing is carried out with 8 bits for data prior to compression and 4 bits for differentials of adjoining data, for a block of 8 * 8 pixels the data amount after compression becomes

$$\text{(data amount after compression)} = 8 * ((8 + 4 * (8 - 1)) = 288 \text{ bits} \tag{5}$$

Thus the compressing rate is approximately 50%.

The above compression method used a pixel on the upper left or far left as the standard, but it is not restricted to these pixels. As a further example, a block can also be further subdivided at each line or each column, for instance a block of 4 * 4 pixels can be divided into 4 sections.

Moreover, the above describes an example wherein 4-bit quantizing is used for an 8 * 8 pixel block, but the block size and quantizing bit number can also be chosen as deemed appropriate.

absolute value of the difference, the curve becomes practically zero. In consideration of this characteristic, a short word-length is allocated when the differences of the image data (the differences of the coded data) are close to zero, and a long word-length is allocated as the difference becomes larger. Such allocation is termed Huffman coding, an example of which is shown in Fig. 11. When such allocating is carried out, near zero the data amount decreases due to the short word-length and since incidence here is high, the data amount of the entire block is also reduced.

The compressing portion 102 first compresses the decoded data according to the above-mentioned Huffman coding, and the block data amount controlling portion 107 judges whether or not this data amount is less than the maximum value U. If the data amount is less than the predetermined maximum value U, further quantizing is not carried out. Since in the above-mentioned Huffman coding differences of the coded data are merely being substituted, no image deterioration is caused. Thus, in this case, no image deterioration is caused.

If the data amount of the data compressed according to Huffman coding is greater than the maximum permitted value, further compressing is carried out by a method such as according to the equations (1) and (2) described in the first embodiment. In the first embodiment differences of the coded data were quantizing using 4 bits, but, in the present embodiment the block data amount controlling portion 107 determines a quantizing bit number w which will ensure that the data amount after compressing is less than the maximum permitted value, and quantizing is carried out at the compressing portion 102 based on this quantizing bit number. An example of the data before and after being quantized in this quantizing processing is shown in Fig. 12. As Fig. 12 shows, in a case where quantizing is carried out with 4 bits, a resulting quantizing of $(2^{(w-1)} - 1) * 2 + 1$ is carried out. In other words, for image data which has a large data amount the bit number w is decreased and the compressing range is widened, and for data having a small data amount the bit number w is increased and the compressing range is narrowed to control image deterioration due to compressing.

Embodiment 3

Fig. 13 is a general block diagram showing a general configuration of a third embodiment of the present invention. The coding process is identical to that in the first and second embodiments and its explanation is omitted here. The present embodiment is the same as the second embodiment but is characterized in that a frame data amount controlling portion 108 has been provided. The frame data amount controlling portion 108 is connected to the block data amount controlling portion 107 through a controlling line 161. The frame data amount controlling portion 108 monitors the data amount of each frame after compression processing to ensure that the data amount for each frame is less than a predetermined frame value S. If the data amount is above the predetermined frame amounts, the compressing portion 102 is instructed to change the compressing rate and recompress. Since the data amount for 1 block of compressed image data is adjusted in response to the image, the address controlling portion 106 stores the addresses of the prediction / display frame memory portion 103 in which the data for each block has been written. Decompression of the compressed data is then carried out in compliance with these addresses at the decompressing A portion 104 and the decompressing B portion 105.

Fig. 14 will be used to explain the operation of the data amount controlling portion 108. The horizontal axis indicates the time required for compressing processing, a block is sequentially compressed in raster sequence, and the processing of 1 frame is completed in a time T. The vertical axis indicates the information amount after compressing, and the predetermined maximum information value for 1 image frame is the frame value S bits. The frame value S is determined according to the capacity of the prediction / display frame memory portion 103. If the data amount of compressed image data increases proportional to the number of blocks for which compressing processing has been completed, that is, if it increases along the dashed line R in the center of the diagram, the data amount attains its maximum permitted value when the processing of 1 frame is completed.

However, depending on the image which is to be compressed, the image quality of certain images can be maintained even after substantial compressing, while there are other images which must be compressed as little as possible to maintain the image quality. At a predetermined point during the processing of 1 frame, the frame data amount controlling portion 108 compares the data amount generated up to that point with the proportionally increasing standard value R and executes an instruction to alter the compressing rate to ensure that the data amount at the point of completion of the processing of 1 frame will attain the maximum permitted value S. For instance, if the amount of information compressed by a time $t_1$ as indicated by the graph line H is large in comparison with the standard value R, in the subsequent processing an instruction is executed to alter the compressing rate so that more substantial compressing is carried out. Alternatively, if the amount of information compressed by a time $t_1$ as indicated by the graph line L is small in comparison with the standard value R, in the subsequent processing an instruction is executed to alter the compressing rate so that less substantial compressing is carried out.

Alteration of the compressing rate is carried out as follows. As in the second embodiment, Huffman coding is first applied to the decoded data at the compressing portion 102. Then, at a designated time $t_1$ the total of the data amount of the blocks processed up to that time is compared with the standard value R. Then, as described above, judgment is made with regard to the alteration of the subsequent compressing rate based on this comparison. In a case where it has been judged that alteration of the compressing rate is necessary, the frame data amount controlling portion 108

the coded data of adjoining pixels within the pixel row to which the pixels belong.

5. A digital image decoding apparatus according to claims 1 or 2, wherein

the compressing means allocates a small amount of information to a high frequency signal and allocates a large amount of information to a low frequency signal, when compressing.

6. A digital image decoding apparatus according to claims 1 or 2, further comprising

a block data amount controlling means for controlling the compressing rate to ensure that the data amount of each block which has been compressed by the compressing means will be less than a predetermined maximum permitted block data amount.

7. A digital image decoding apparatus according to claim 6, further comprising

a frame data amount controlling means for comparing, at a predetermined time during the compression operation of one image frame, the total data amount with the standard data amount at the predetermined time, and for operating such that, if the total data amount has exceeded the standard data amount, the maximum permitted block data amount in subsequent compressing will be set at a lower value, and, if the total data amount is less than the standard data amount, the maximum permitted block data amount in the subsequent compressing will be set at a higher value,
resulting in control of the compressing rate to ensure that the data amount after compression by the compressing means is less than the predetermined data amount for one frame.

8. A digital image decoding apparatus according to claims 6 or 7, wherein

the compressing means compresses the data of each block, both by
a first compressing method in which one of the pixels which constitute the block is deemed a standard pixel and the data of pixels other than the standard pixel are expressed as differences of the coded data between adjoining pixels, and a short word-length is allocated for these differences of the coded data when the differences of the coded data are close to zero and a long word-length is allocated for the differences of the coded data which are larger,
and by a second compressing method in which one of the pixels which constitute the block is deemed a standard pixel and first the data of the standard pixel is quantized, and then the data of pixels other than the standard pixel are quantized, with a predetermined quantization bit number, based on the differences of the coded data of adjoining pixels; and
the block data amount controlling means operates such that, if the data amount of the data which have been compressed by the first compressing method of the compressing means is less than the maximum permitted block data amount, an instruction is sent to the compressing means to output the data resulting from the first compressing method and, if the data amount of the data which have been compressed by the first compressing method is greater than the maximum permitted block data amount, the block data amount controlling means chooses a quantization bit number to ensure that the data amount will be less than the maximum permitted block data amount, and sends an instruction to the compressing means to compress the data resulting from the second compressing method using this chosen quantization bit number.

9. A digital image decoding apparatus according to claims 6 or 7, wherein

the compressing means compresses the data of each block, both by
a first compressing method in which one of the pixels which constitute the block is deemed a standard pixel and the data of pixels other than the standard pixel are expressed as differences of the coded data between adjoining pixels, and a short word-length is allocated for these differences of the coded data when the differences are close to zero and a long word-length is allocated for the differences which are larger,
and by a second compressing method in which one pixel in each of the pixel rows of the block is deemed a standard pixel and first the data of the standard pixel is quantized, and then the data of pixels other than the standard pixel are with a predetermined quantization bit number, quantized, based on the differences of the coded data of adjoining pixels within the pixel row to which the pixel belongs; and
the block data amount controlling means operates such that, if the data amount of the data which have been compressed by the first compressing method of the compressing means is less than the predetermined value, an instruction is sent to the compressing means to output the data resulting from the first compressing method

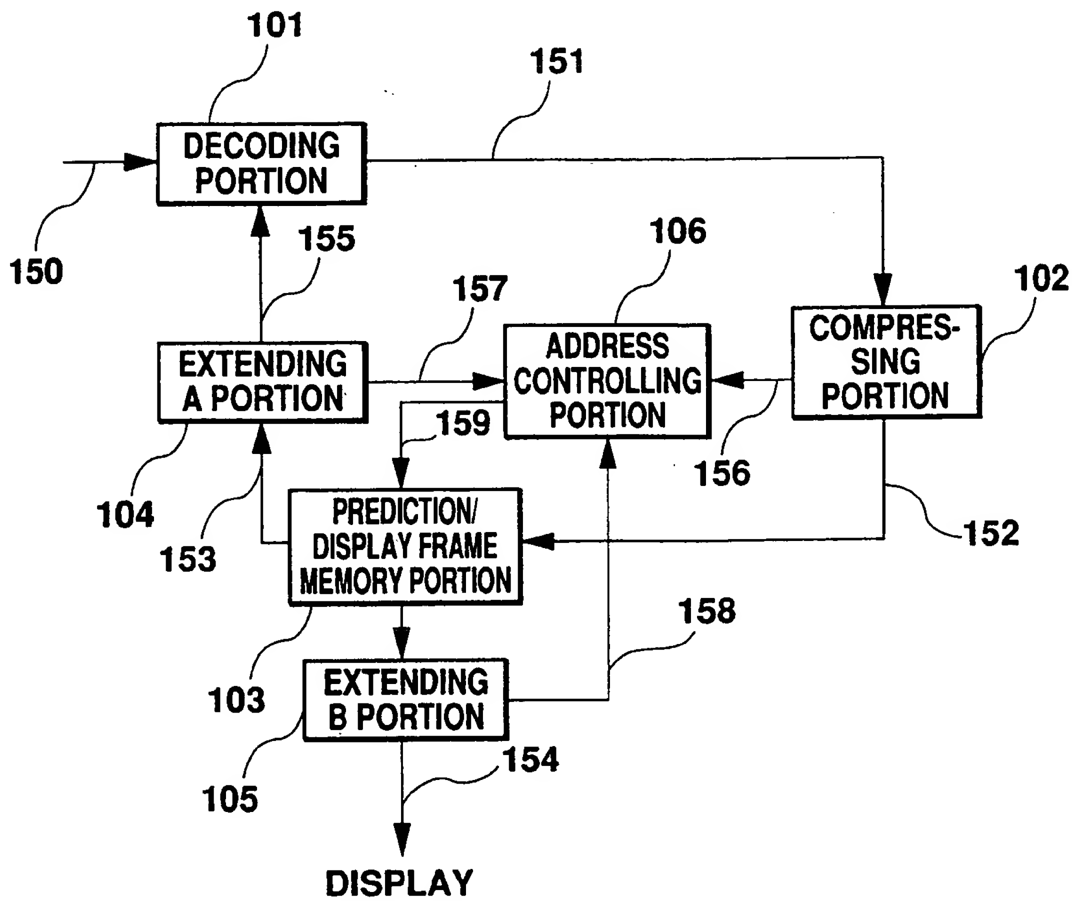

101
151
DECODING PORTION
150
155
106
157
102
EXTENDING A PORTION
ADDRESS CONTROLLING PORTION
COMPRES-SING PORTION
159
104
156
153
PREDICTION/ DISPLAY FRAME MEMORY PORTION
152
158
103
EXTENDING B PORTION
154
105
DISPLAY

Fig. 1

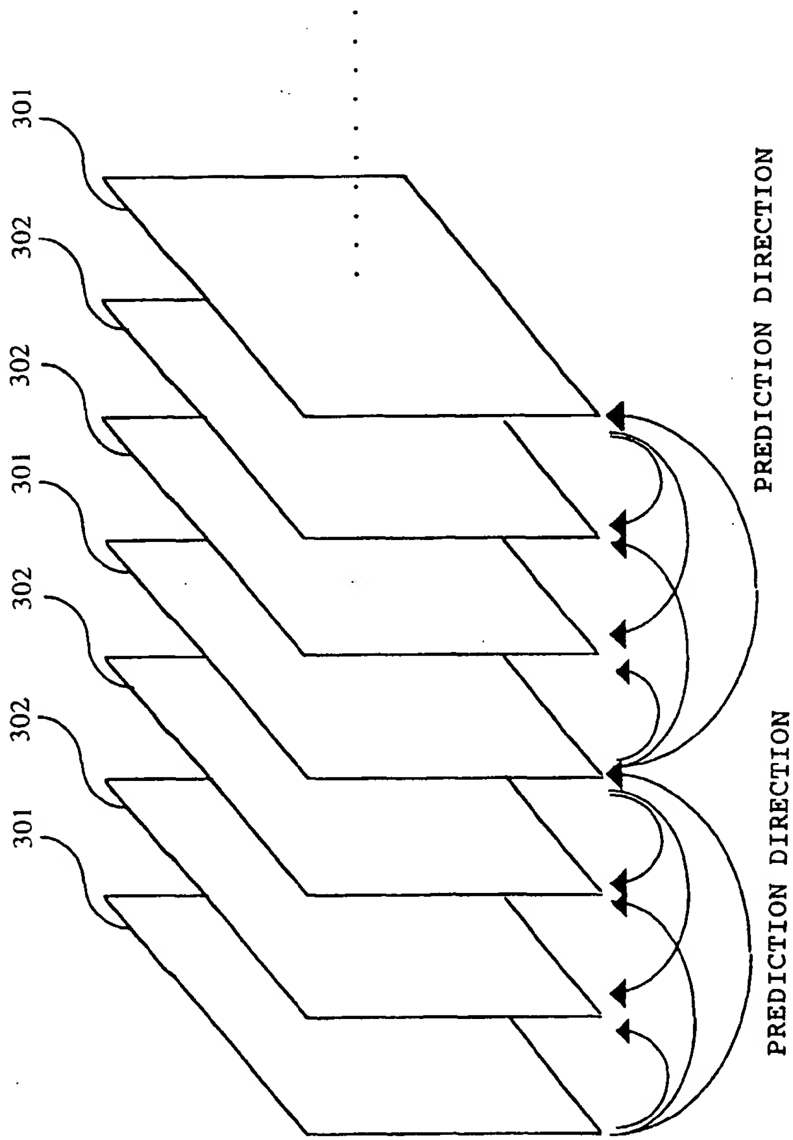

301
302
302
301
302
302
301
PREDICTION DIRECTION
PREDICTION DIRECTION

Fig. 3

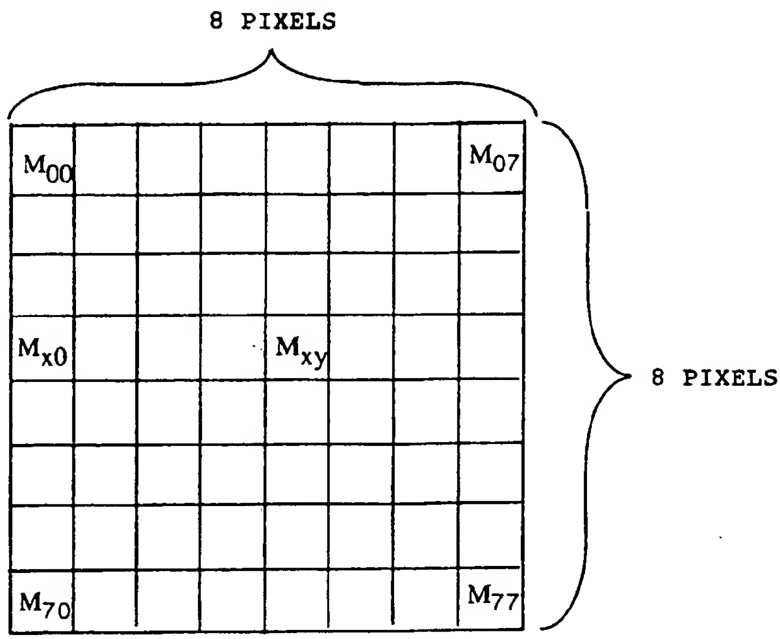

8 PIXELS
$M_{00}$
$M_{07}$
$M_{x0}$
$M_{xy}$
8 PIXELS
$M_{70}$
$M_{77}$

Fig. 5

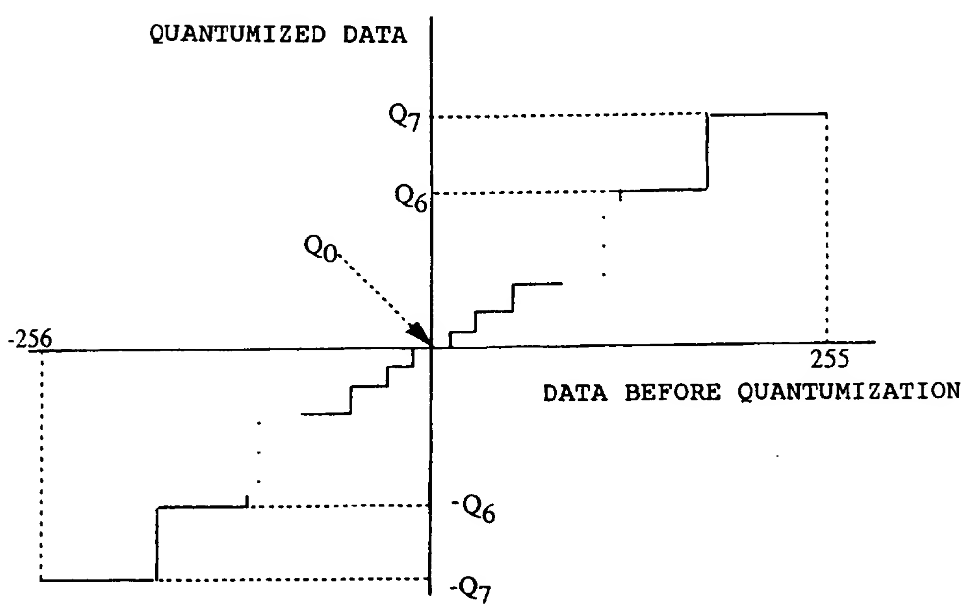
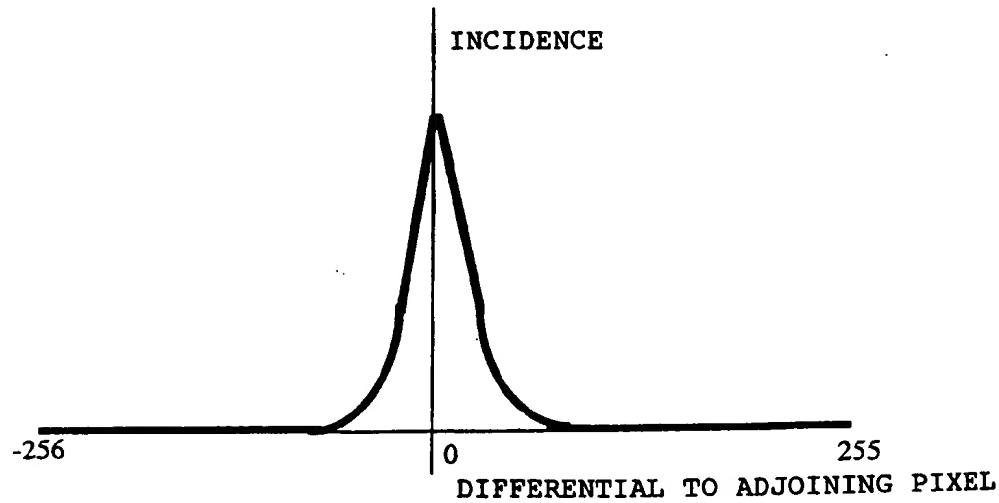

QUANTUMIZED DATA
$Q_7$
$Q_6$
$Q_0$
-256
255
DATA BEFORE QUANTUMIZATION
$-Q_6$
$-Q_7$

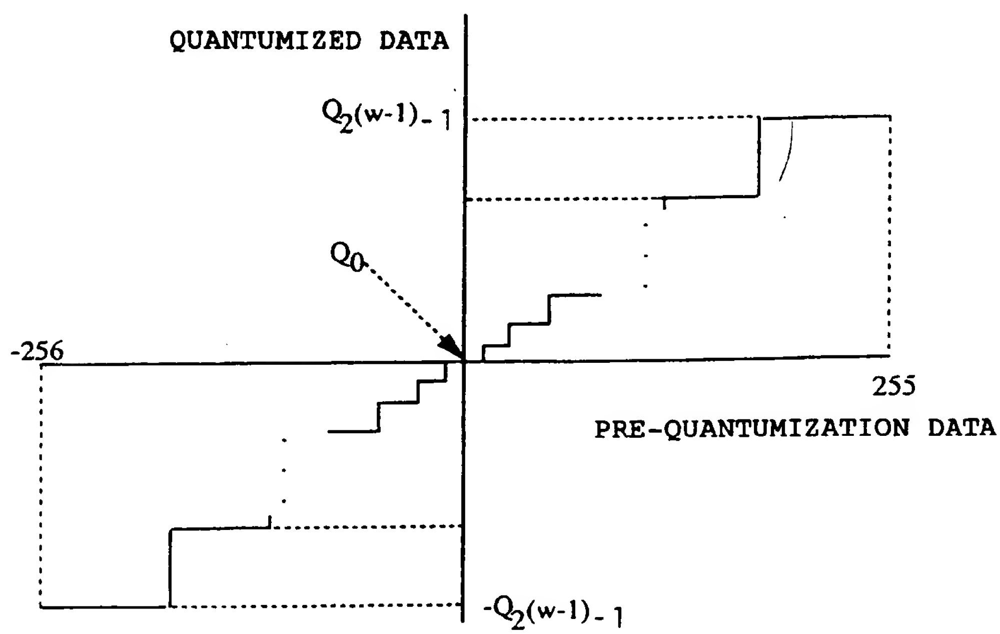
Fig. 6

$$A=\begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 \\ 2 & 2 & -2 & -2 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2 & 2 & -2 & -2 \\ 2 & -2 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 2 & -2 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2 & -2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 2 & -2 \end{bmatrix}$$

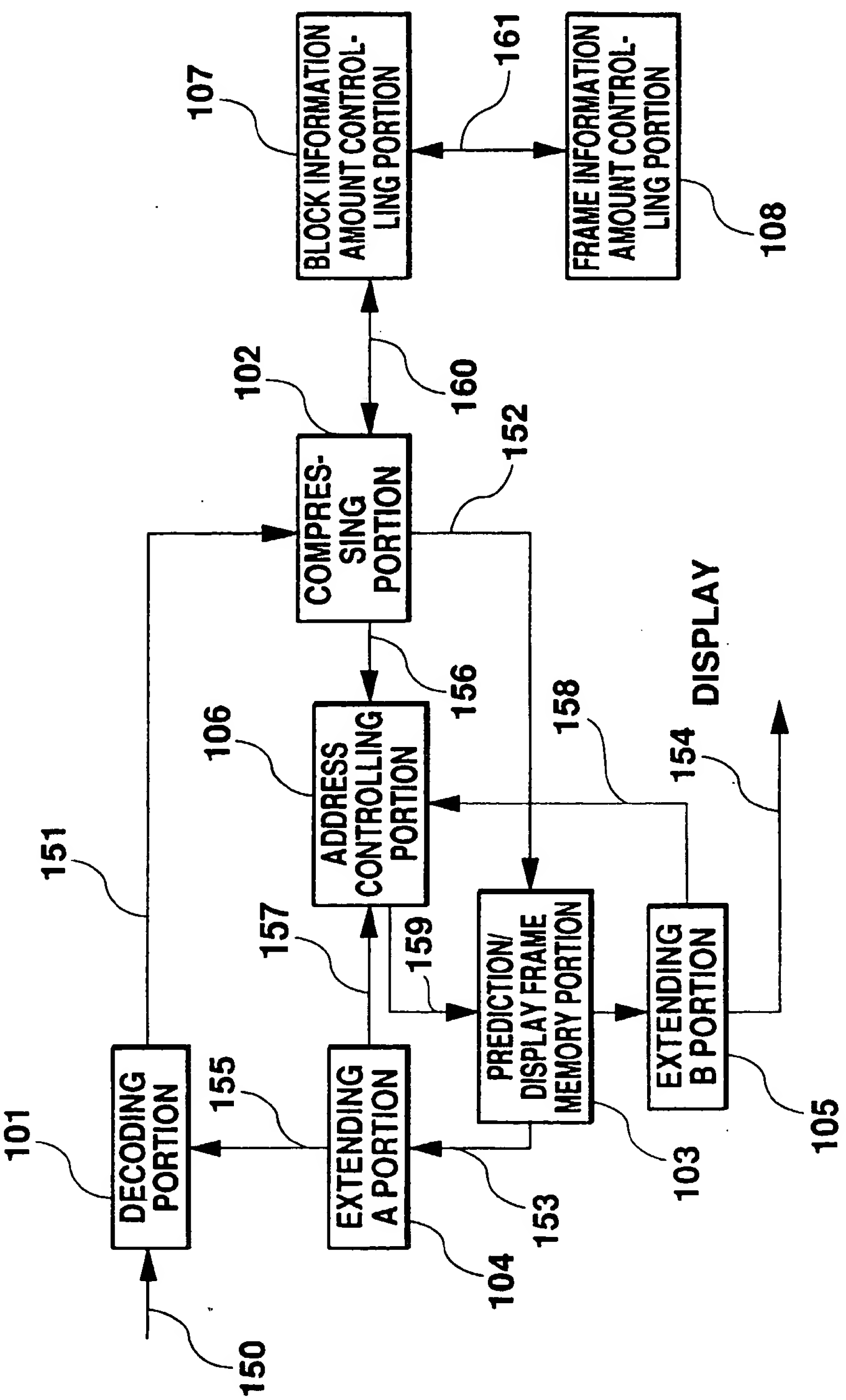
Fig. 8


INCIDENCE
-256
0
255
DIFFERENTIAL TO ADJOINING PIXEL

# Fig. 10

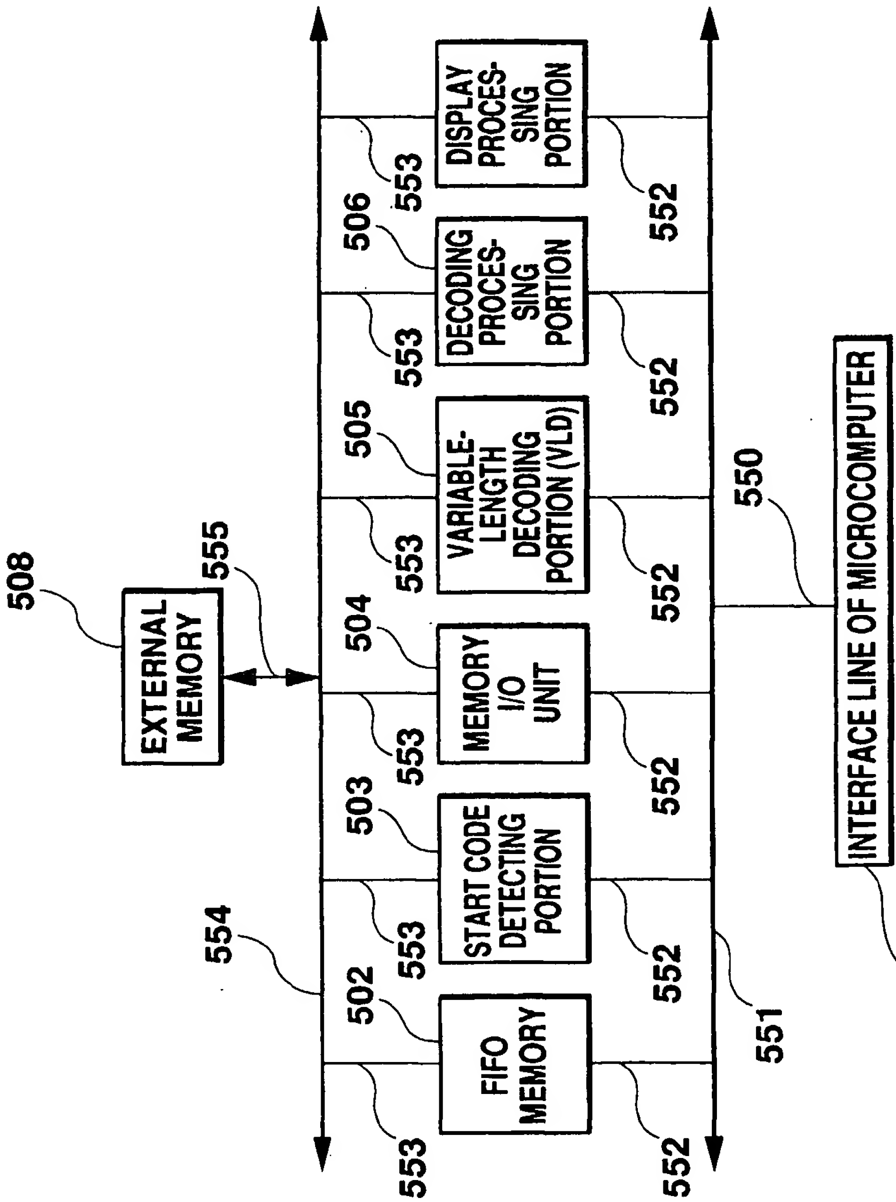

QUANTUMIZED DATA
Q2(w-1)- 1
Q0
-256
255
PRE-QUANTUMIZATION DATA
-Q2(w-1)- 1

# Fig. 11



BLOCK INFORMATION AMOUNT CONTROL-LING PORTION
107
161
FRAME INFORMATION AMOUNT CONTRO-LING PORTION
108
102
160
COMPRES-SING PORTION
152
156
DISPLAY
106
ADDRESS CONTROLLING PORTION
158
154
151
157
159
PREDICTION/ DISPLAY FRAME MEMORY PORTION
EXTENDING B PORTION
101
DECODING PORTION
155
EXTENDING A PORTION
153
103
105
104
150


Fig. 13



508
EXTERNAL MEMORY
555
554
502
FIFO MEMORY
503
START CODE DETECTING PORTION
504
MEMORY I/O UNIT
505
VARIABLE-LENGTH DECODING PORTION (VLD)
506
DECODING PROCES-SING PORTION
DISPLAY PROCES-SING PORTION
553
552
550
551
INTERFACE LINE OF MICROCOMPUTER
501


Fig. 15

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## (54) Digital image decoding apparatus

(57) Data which has been decoded by a decoding portion 101 are compressed by a compressing portion 102 and stored in a prediction / display frame memory portion 103. From the data stored in the prediction / display frame memory portion 103, any data required for decoding other frames in the decoding portion 101 are decompressed through a decompressing A portion 104 and supplied to the decoding portion 101. Alternatively, data to be displayed is read from the prediction / display frame memory portion 103, decompressed at a decompressing B portion 105 and supplied to a display apparatus. Writing to and reading from the above-mentioned prediction / display frame memory portion 103 is controlled by an address controlling portion 106. Since compressed data are stored in the prediction / display frame memory portion 103, the memory capacity can be decreased.

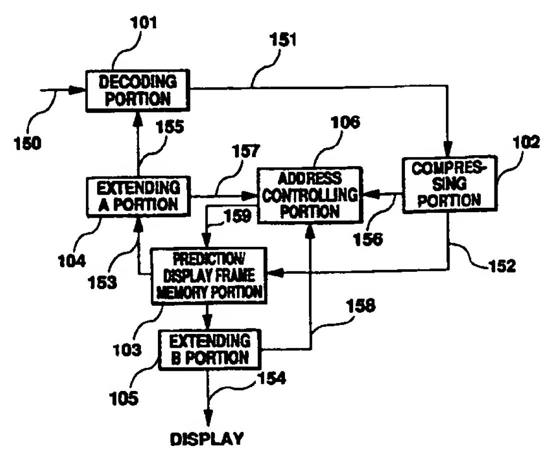


Fig. 1

EP 0 794 672 A3

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 96 11 5111

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| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 16 May 2000 | La, V |

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X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 96 11 5111

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-5

A digital image decoder comprising a decoding means for decoding inter-frame coded image data, a compressing means for compressing decoded data, a prediction frame memory means for storing at least one image frame of the compressed data, a decompressing means for decompressing the compressed data which has been stored in the prediction frame memory means, and an address controlling means for controlling the writing of the compressed data to the prediction frame memory means and the reading of the compressed data from the prediction frame memory means,
further including a display frame memory means for storing at least one image frame of the compressed data, said image frame to be used for display only.

1.1. Claim : 4
A digital image decoder comprising a decoding means for decoding inter-frame coded image data, a compressing means for compressing decoded data, a prediction frame memory means for storing at least one image frame of the compressed data, a decompressing means for decompressing the compressed data which has been stored in the prediction frame memory means, and an address controlling means for controlling the writing of the compressed data to the prediction frame memory means and the reading of the compressed data from the prediction frame memory means,
wherein the compressing means selects one standard pixel from each pixel row of the block, and first quantizes the data of the standard pixel,
and then quantizes pixels other than the standard pixel based on the differences of the coded data of adjoining pixels within the pixel row to which the pixels belong.

1.2. Claim : 5
A digital image decoder comprising a decoding means for decoding inter-frame coded image data, a compressing means for compressing decoded data, a prediction frame memory means for storing at least one image frame of the compressed data, a decompressing means for decompressing the compressed data which has been stored in the prediction frame memory means, and an address controlling means for controlling the writing of the compressed data to the prediction frame memory means and the reading of the compressed data from the prediction frame memory means,

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 96 11 5111

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-05-2000

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